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ABSTRACT

This document describes an introduction course in the fundamentals of chemistry for marine engineers. The course is modularized, audio tutorial allowing the student to progress at his own rate while integrating laboratory and lecture materials. (SL)

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AN INTRODUCTION TO THE FUNDAMENTALS OF CHEMISTRY FOR THE MARINE ENGINEER

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ABSTRACT

An Introduction to the Fundamentals of Chemistry for the Marine Engineer is a modularized audio tutorial course. It allows the student to work and progress at his own rate. In addition, the course integrates the laboratory and lecture material.

INTRODUCTION

An Introduction to the Fundamentals of Chemistry for the Marine Engineer attempts to attend to the varying abilities and interests of a variety of students. It is a modular, self-paced, audio-tutorial, contract graded course. This means that the student decides what competency level he wishes to attain (this is accomplished through the contract grade) then proceeds, at his own rate using the audio-tutorial approach, to attain that level.

The course is combination lecture-laboratory course. The lectures and discussions of the various concepts are presented to the student via audio-tape, and essential features are emphasized with 35mm slides. For students who prefer to read rather than listen, tapescripts may be checked out from your instructor. (The tapescripts contain exactly the same information as do the tapes.) Laboratory exercises are included where they are relevant. When the student encounters a laboratory activity he is expected to stop, conduct the activity, gather the data, etc., and then proceed.

The course is composed of seventeen modules. Eight of the modules are required in order to attain the various competency levels. In addition, there are four elective modules, and five modules which attend to remedial mathematics skills. The modules are titled:

Module	Title
D-1	Elementary Background
D-2	Low Pressure Boiler Water Treatment
C-1	Chemical Reactions
C-2	Quantitative Relationships
C-3	Solutions
C-4	Corrosion
B-1	Chemical Reactions
A-1	Atomic Theory
E-1	Organic Chemistry
E-2	Toxic Substances in the Environment
E-3	Water Pollution and Waste Treatment
E-4	High Pressure Boiler Water Treatment
R-1	Metric System
R-2	Signigicant Figures and Rounding
R-3	Scientific Notation - Exponential Form
R-4	Algebraic Operations
R-5	Logarithms

Successful completion of the course requires that the student spend approximately three hours each week of in-class time. Your instructor has a schedule listing the times each week during which the laboratory-classroom will be open. The laboratory is designed for eight learning stations and each station will accommodate two students. The laboratory will be open each week for a time sufficient to allow each student the required three hours of in-class time plus approximately one additional hour. In order to avoid confusion, students are requested to reserve a learning station for at least

three hours during the week. That station will then be available for your use during the time for which you have reserved it. You may reserve one three hour time block, one hour on each of three different days, etc. However, it is suggested that you reserve one three hour time block and attempt to do the majority of your work then.

It is assumed that a student who reserves a learning station will be present during his reserved time. If the station is not occupied by ten minutes after the beginning of the hour for which it is reserved, it may be considered as open and so available for any other students' use.

Finally, you may use any learning station at any time when it is not reserved. A schedule will be posted by each station showing the names of the students who have reserved the station, the times during which the station is reserved, and the times during which the station is available for general use (not reserved). Consult your instructor concerning the reservation of a station.

Each student will be required to keep a time card. The time cards will be left in the classroom-laboratory. When you come to use a learning station, you should pick up your time card (stored in the containers near the classroom door) and note the time you arrived. Then, when you are ready to leave, note your departure time on your time card and have it initialed by the instructor.

An instructor will be in the classroom-laboratory at all times to assist you. You should seek assistance whenever it is necessary; however, before seeking assistance see if you can solve your problem using the supplementary text materials which you have purchased and/or using those materials which are available in the laboratory.

OBJECTIVES

The objectives of the course are:

1. To introduce the student to the fundamentals of chemistry.

2. To provide the student with basic skills in the area of boiler water analysis tests.

3. To provide the student a basic understanding of the problems caused by faulty boiler water treatment.

4. To provide the student with an understanding of what types of boiler water treatments will minimize damage to boiler tubes caused by the mineral content of water and maximize the life of the ship's boilers.

COURSE GRADE

The course grade is determined by contract. That is, the student decides the competency level he wishes to attain and then contracts to do the work necessary to attain that level.

The grading policy is also open-ended. The student is expected to fill out a grade contract during the first week of the semester indicating the grade for which he intends to work. However, if anytime during the semester, but not later than the last week of classes, the student finds his original contract to be unrealistic he may down-contract. If, on the other hand, he finds his original contracted grade to be too low, he may raise his contract.

The following requirements are established as minimums:

If the student wishes to attain the D competency level (a D level contract) he must successfully complete Modules D-1 and D-2.

A grade of C requires that the student successfully complete Modules D-1, D-2, C-1, C-2, C-3 and C-4.

In order to obtain a grade of B, the student must meet the requirements for the D and C grades and in addition he must complete Module B-1 plus two elective Modules (E-1 through E-4).

A student who wishes to attain the A competency level must meet all of the requirements for the D, C, and B competency levels plus Module A-1 and a third elective Module.

If a student should fail to meet the requirements of his contract, the contract will be voided. In this case, all of the student's previous work will be evaluated. If that work has been exceptional, the student may possibly be awarded the grade for which he originally contracted. If, on the other hand, all of the student's work has been marginal, he might expect the grade to drop at least one grade below that of the original contracted grade. In any event, if a student fails to meet his contract, the grade will then be determined by the instructor.

ATTENDANCE POLICY

The course does not carry a mandatory attendance policy. However, although there is no required attendance policy, the student is expected to spend sufficient time in order to meet his contract grade obligations. Once the student meets the obligations of the grade for which he contracted he need not return to the laboratory classroom for the remainder of the semester. A specified amount of material must be mastered. After mastery has been demonstrated the student will be awarded the grade for which he contracted. This however, should not be misconstrued to mean the student needs to complete his chemistry work prior to the end of the semester. Each student is welcome to work up to and including the last day of classes preceding the final exam period.

EXAMINATIONS

After the student has completed what he considers to be sufficient study on a module, he should contact an instructor concerning an examination over material covered in the module.

Some of the end of module examinations are essay, some are short answers, and in some isolated cases an examination may be oral. All of the exams are pass/fail.

A pass on an examination means that the student has learned the material well enough to be considered minimumly competent with the subject matter dealt with in the module. A failure on an exam indicates that the student has not yet learned the material in a module to a level sufficient to demonstrate minimum competency. A student may take as many exams as are necessary in order to receive a passing grade. However, a student may not take more than one examination on the same day. Finally, a pass on an examination means that a student has answered 90% of the items correctly on the examination.

All examinations will be administered during one three hour period each week. The examination period will be posted. Regardless of which module a student is completing, the exam will be taken during the exam period.

PROBLEM SETS

Each module has an associated problem set. These problem sets are taken from your supplementary text and related to the respective module and the course in general. The problem set for each module must be successfully completed (70%) as part of the module requirement. In addition, the student must complete the

problem set and have it graded prior to taking the end of the module examination for the first time.

COURSE TIME LINE

The only time limitations on completion of modules exists at the D level. All students must have completed the D-1 module, it associated problem set, and have taken the first D-1 end of module examination not later than the end of the testing session during the fourth week of classes.

Equipment for the D-2 module will be set up starting the third week of the semester. The equipment will remain set up until the end of the seventh week of classes. All students must have completed the D-2 module, the D-2 module problem set, and be prepared to take the D-2 end of module examination not later than the end of the seventh week of classes.

MODULE OUTLINES

1. Module D-1, Elementary Background

   A. Substances and Mixtures.
   B. Physical properties (phase, density, solubility, luster, ductility, malleability, tenacity, brittleness).
   C. Classification of matter (elements, compounds, mixtures).
   D. Nuclear model of the atom (electrons, protons, neutrons).
   E. Electrovalence and covalence.
   F. Periodic Table, its purposes and arrangement
   G. Writing formulas and equations.
   H. Solutions (ions in solution, processes of ionization and dissociation, reactions in solutions).

2. Module D-2, Low Pressure Boiler Water Treatment

   A. The need for boiler water treatment including corrosion prevention, scale prevention, and foaming and carry-over prevention.
   B. Performance of alkalinity, chloride, phosphate, sulfate, hydrazine, total dissolved solids, and soap hardness tests.

3. Module C-1, Chemical Reactions

   A. A review of symbols and equations.
   B. Chemical reactions and equations (synthesis, single replacement, exchange of ions, decomposition, combinations of reaction types).
   C. Electronic equations (electrochemical, electrolytic, simple electrode reactions).

4. Module C-2, Quantitative Relationships

   A. Determination of atomic and molecular weights.
   B. The concept of the mole.
   C. The study of simple weight-weight, weight-volume, and volume-volume problems.

5. Module C-3, Solutions

   A. Measurement of concentrations.
   B. A study of the concepts of saturation, supersaturation and the limits of solubility.
   C. The numerical aspects of solutions (percent solution, ppm, gpg, molarity, normality).
   D. Factors affecting solubility.
   E. Reactions which occur in solution (acid-base neutralization, pH and its effect on scale and protective coatings).

6. Module C-4, Corrosion

   A. The effects of corrosion.
   B. The causes of corrosion (oxygen, carbon dioxide, acid and caustic causes, ammonia, stress, velocity, hydrogen, embrittlement).

7. Module B-1, Chemical Reactions

   A. Energy effects in chemical reactions (temperature, heat and its measurement, heat content, heat of reaction, conservation of energy).
   B. Rates of reaction (activation energy, catalysis).
   C. Equilibrium (open and closed systems, factors affecting equilibrium, equilibrium constants, pH, precipitation).

8. Module A-1, Atomic Theory

   A. Spectra, their causes and interpretations.
   B. The Bohr model.
   C. Atom shell populations and energy levels.
   D. The Periodic Table and electron configurations.
   E. Electron configurations and bonding types.

9. Module E-1, Organic Chemistry

   A. The characteristic of carbons.
   B. Structural formulas.
   C. Classification of organic compounds (aliphatic, aromatic, substitution products).

10. Module E-2, Toxic Substances

   A. Classification of toxic substances
   B. Examples of physiological effects of each class (corrosive, metabolic, neurotoxic, mutagenic, carcenogenic).
   C. Halucinogens

11. Module E-3, Water Pollution and Waste Treatment

   A. Natural water purification.
   B. Pollution types (thermal, sewage, fertilizers, syndets, pestacides, industrial wastes, silt).
   C. Water purification (common municipal systems, hard water and sea water, distillation, freezing, hydrate formation, ion exchange, electrodialysis, reverse osmosis).

12. Module E-4, High Pressure Boiler Water Treatment

   A. Constraints of high pressure systems.
   B. The coordinated phosphate theory.
   C. The Ultra Marine System of Drew Chemical Company.
   D. Special trace element tests.
   E. Special analytical methods.
   F. Automated systems.

Modules R-1 through R-4 will not be discussed here. They are remedial in nature and are available for those students who encounter mathematical difficulties as they proceed through the various other modules. They are not to be used as elective modules.

PROCEDURES

1. The student picks up his time card and fills in the time he entered class.
2. The student works on a module at his own pace.
3. The student does the laboratory activities which are required by the module.
4. The student works on and completes the problem set associated with a given module.
5. The student, upon completing a module, contacts an instructor in order to take the end of the module examination.
6. The student begins the next module.
7. Upon departure from the classroom-laboratory, the student fills in his departure time on his time card and then has the instructor initial the card.

MATERIALS

1. Each learning station requires one slide projector and two audio tape players.
2. Audio cassette tapes for each learning station. There should be two tapes of each module for each learning station.
3. Slide carrousels for each learning station. There should be at least one set of slides for each learning station of modules D-1, D-2, C-1, C-2, C-3, and C-4. In addition, it is advisable to have at least one set of slides each for modules B-1, A-1, E-1, E-2, E-3, E-4, R-1, R-2, R-3, R-4, and R-5 for each learning station.
4. Sufficient quantities of equipment and chemicals so that students can perform the various laboratory experiments required by the modules.
5. Reference texts and other paper aids of the students.

SAMPLE GRADING CONTRACT FOR Ch-1

The course grade will be determined by contract.

1. For a grade of D, the student must complete modules D-1 and D-2.

2. For a grade of C, the student must complete modules D-1, D-2, C-1, C-2, C-3, and C-4.

3. For a grade of B, the student must complete modules D-1, D-2, C-1, C-2, C-3,, C-4, B-1, and two E modules (E level modules).

4. For a grade of A, the student must complete modules D-1, D-2, C-1, C-2, C-3, C-4, B-1, A-1, and three elective modules (E level modules).

The student may up or down contract at any time prior to the last week of class during the semester.

Name _____ Date _____

Identification Number _____

I wish to work for a grade of _____

TEXTS AND OTHER PRINTED MATERIALS

1. The current supplementary text.

2. Boiler and Feedwater Conditioning. Bull and Roberts, Inc., 785 Central Avenue, Murray Hill, N.J. 07974

3. Chemical Analysis of Water. Ameriod Marine Division, Drew Chemical Company, 701 Jefferson Road, Parsippany, N.J.

4. Marine Water Treatment. Ameriod Marine Division, Drew Chemical Company, 701 Jefferson Road, Parsippany, N.J.

5. Practical Water Treatment for Marine Boilers. Magnus Maritec International Inc., 860 River Road, Edgewater, N.J.

BIBLIOGRAPHY

1. Acidity or Alkalinity of Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

2. Berk, A. A., Questions and Answers on Boiler - Feedwater Conditioning. United States Department of the Interior, U.S. Government Printing Office, Washington, D.C. 20402.

3. Boiler and Feedwater Conditioning. Bull and Roberts, Inc., 785 Central Avenue, Murray Hill, N.J. 07974.

4. Carbon Dioxide and Bicarbonate and Carbonate Ions in Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

5. Chemical Analysis of Water. Ameriod Marine Division, Drew Chemical Company, 701 Jefferson Road, Parsippany, New Jersey.

6. Chloride Ion in Industrial Water and Industrial Waste Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

7. Corrosivity Test of Industrial Water (USBM Embrittlement Detector Method). American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

8. Determination of Precision of Methods of Committee D-1 on Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

9. Dissolved Oxygen in Industrial Waste Water. American Society for Testing and Materials, 1916 Race Street, Philadephia, Penna. 19103.

10. Hardness in Industrial Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

11. Hydrazine in Industrial Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

12. Levi, E.J. and McFarlane, J.J., Total Protection for Marine Boiler Water. Paper presented at Mariport '72, Philadelphia, May, 1972. Marine Division, Drew Chemical Corporation, 701 Jefferson Road, Parsippany, New Jersey 07054.

13. Marine Water Treatment. Ameroid Marine Division, Drew Chemical Company, 701 Jefferson Road, Parsippany, N.J.

14. Nitrate Ion in Industrial Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

15. Nitrate Ion in Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

16. Particulate and Dissolved Matter in Industrial Water. American Society for Testing and Materials, 1915 Race Street, Philadelphia, Penna. 19103.

17. pH of Industrial Water and Industrial Waste Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

18. Phosphorus in Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

19. Practical Water Treatment for Marine Boilers. Magnus Maritec International Incorporated, 860 River Road, Edgewater, New Jersey 07020.

20. Preparation, Standardization, and Storage of Standard Solutions for Chemical Analysis. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

21. Reporting Results of Analysis of Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

22. Sampling Industrial Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

23. Sampling Steam. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

24. Seile, B. W. and Westberg, J.E., Boiler Water and Condensate Chemistry Control Considerations. Bull and Roberts, Inc., 785 Central Avenue, Murray Hill, N.J. September 1, 1970.

25. Silica in Industrial Water and Industrial Waste Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

26. Water. American Society for Testing and Materials, 1916 Race Street,Philadelphia, Penna. 19103.

INFORMATION STATEMENT Ch-1

After you have read the introductory information, read the statement below. Once you have read the statement, sign it and return it to your instructor.

I have read the Ch-1 information booklet and understand the information contained therein. I am aware of my obligations while enrolled in the course and further, what is required of me in order to successfully complete the course.

SIGNATURE_____

DATE_____